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ABSTRACT

The idea of the creative individualist spawning innovations as a solitude effort is no longer realistic. Huge innovation projects, relying on project teams, have to be permanently conducted by organizations to assure their competitiveness. These projects often take place in distributed teams, making use of groupware to bridge temporal and geographical distances. Research in social psychology on group processes has revealed that group work suffers from several group process losses such as information overload, production blocking, free riding and evaluation apprehension. Moreover, creative group processes have to be coordinated to assure goal orientation and efficiency. In the shade of the Media Synchronicity Theory and Coordination theory we analyze aspects of communication and coordination support of groupware functionality. We conclude that idea generation should be supported by synchronous groupware functionality whilst idea evaluation merits from asynchronous functionality. Moreover both phases do not depend on single outstanding but various groupware functionalities to support coordination.

Keywords

Creativity, Group Process, Groupware, Media Synchronicity Theory, Coordination Theory

MOTIVATION

Creativity is what allowed mankind to evolve; without the creative mind, "we would find ourselves naked in some primeval forest" (Simonton 2006). Furthermore creativity is necessary for competitive advantage and organizational viability. Without creativity and innovation an organization cannot improve and adapt to environmental changes. However, in an increasingly globalized world, creative work is often conducted by widely distributed groups, which means that they cannot meet physically to communicate, cooperate and collaborate. Thus, information exchange and cooperation is often handled via groupware. We follow the definition of groupware from Ellis et al. (1991) who state that groupware are "computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment". Research in the area of social psychology has shown that group work in general suffers from several group process losses (process losses) such as information overload, production blocking, free riding and evaluation apprehension (Nunamaker et al. 1991; Dennis and Valacich 1993). In order to support distributed creative group work in the best possible way, it is necessary to find the best choice of media for the stages of idea generation and idea evaluation in the creative process (Hitt 1965; Basadur 1995; Runco and Chand 1995). We later argue that the best choice of media is different in those two stages.

Our research concentrates on two aspects: the communication and the coordination of teams in creative group processes. Communication is understood as the interpersonal information exchange (Riemer and Vehring 2008) whereas coordination embraces the managing of dependencies between tasks of the different group members (Crowston et al. 2004). Based on a market survey, developing clusters of different types of groupware functionality (Riemer et al. 2005) and a more conceptually oriented clustering (Fouss & Chang 2008) we subsequently differentiate groupware functionality for communication purpose on the one side and coordination purpose functionality on the other side. The latter is further structured in the three clusters: time management, file sharing and task management. We admit, that most communication functionality, such as messengers

or internet forums, allow for coordination. However coordination through informal communication can lead to less efficient management of task dependencies.

We seek to improve the ability of creative groups to communicate effectively by giving recommendations about the right choice of media in a specific stage of the creative process for a distributed creative group. Moreover we strive to identify appropriate groupware functionality to support the coordination of creative group processes. Hence the research question of this paper is twofold: (1) What is the media profile and corresponding groupware functionality to best reduce process losses in creative group processes? (2) Which coordination processes do occur in creative group processes and how can they be supported by groupware functionality?

In order to answer this research questions, the following sub-questions will guide the section-specific division:

- What is the applied research framework and methodology?
- What are the essential concepts of the research framework?
- Which process losses and coordination processes are of relevance for the phases of idea generation and evaluation?
- How can process losses be optimally reduced by the right choice of media?
- Which groupware functions support the identified media profiles and coordination processes?

The paper concludes with a result summary and a discussion of potentially fruitful avenues for future research.

RESEARCH FRAMEWORK

The focus of this paper is the impact of the application of specific groupware functionality on the correlation of process losses and coordination processes on group performance (see Figure 1). We analyze this impact from the point of view of the Media Synchronicity Theory (Dennis & Valacich 1999) and Coordination Theory (Malone & Crowston 1994) and derive recommendations for appropriate groupware application.

Our analysis is based on the review of literature from different disciplines. Webster & Watson (2002) state that literature reviews often differ significantly in both structure and format. Therefore we apply the taxonomy of literature reviews proposed by Cooper (1988) that defines six substantial review characteristics: (1) focus, (2) goal, (3) perspective, (4) coverage, (5) organization and (6) audience. In short, the research objective (2) is expressed by the aforementioned research question that we want to answer in a preferably neutral way (3) and thereby lay the basis for recommendations for IS architects, both scientist and practitioners, of Groupware systems (6). In our analyses we focus on literature of the areas of social psychology, creativity research and information systems (1) based on this research framework (5).

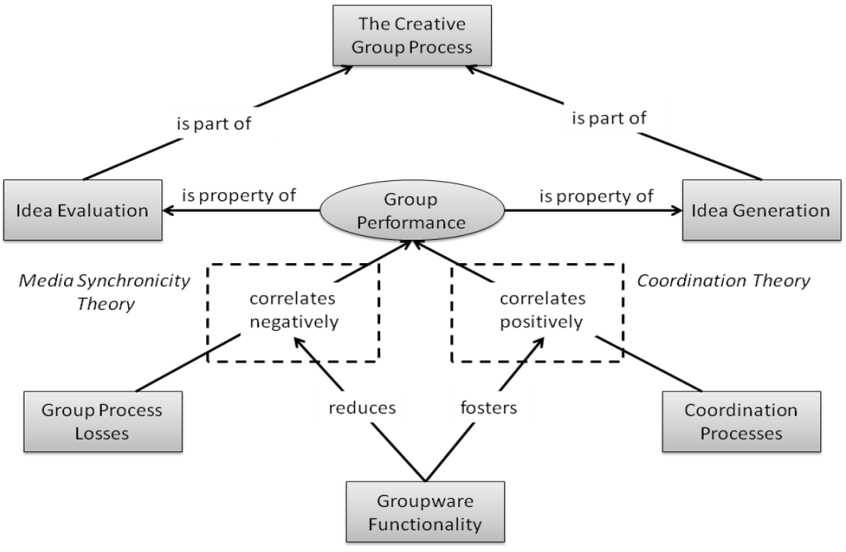


Figure 1: Research Framework

In the following section the body of knowledge for the single components of our research framework is presented.

ESSENTIAL CONCEPTS

The Creative Process

In the past century, one of the major topics of creativity research has been the creative process. Wallas (1926) presented the four-stage model of the creative process (preparation, incubation, illumination and verification). A lot of researchers adhered to this model or revised it slightly (Osborn 1957; Shneiderman 2000). Although this model was discussed in the context of individual creativity, Amabile (1988) proposed similar stages for an organizational setting.

For the problem at hand, the definitions of Hitt (1965), Basadur (1995) or Runco and Chand (1995), which focus on the processes of idea generation and idea evaluation, appear more adequate since they concentrate on the rough distinction between divergent thinking (i.e. generating many alternative ideas in the idea generation phase) and convergent thinking (merge many ideas to concentrate on a few promising ideas/concepts in the evaluation phase). These two phases open way for their application not only to individual but also to group processes (see also Helquist et al. 2008).

Group Processes

Concerning group processes and group performance, vast empirical research has been conducted in the field of social psychology in the 1960s and 1970s. One focus has been the interaction processes which take place among group members while they are working on a task (Hackman and Morris, 1978). "A group is more than the sum of its parts." This proposition was subject to numerous research contributions on group processes in the discipline of social psychology. It was confirmed in several experiments (e.g. Osborn 1957, Hall 1971, Santanen et al. 2000; Kristensson and Norlander 2003) but also partly refuted. Taylor et al. (1958) revealed that nominal groups, i.e. individuals working on their own and having their results evaluated as if they had actually worked together, predominantly outperformed real groups. The assumption that potential performance of real groups is higher than the sum of individuals is highly recognized – but why does empirical research of the last fifty years suggest so controversy on this insight?

Group Process Losses

One answer can surely be found in group process losses which have been identified to occur in group process work, or more concretely in verbal group processes (Steiner 1972). Nunamaker et al. (1991) list at least 18 process losses occurring in group processes. Most cited in literature and subject to further examination are however only four of these: information overload, production blocking, evaluation apprehension and free riding (Dennis and Valacich 1993; Mejias 2007).

Information overload can have two main reasons: First, entirely wrong information may be articulated, due to bad understanding of the problem. Secondly, more information is brought onto the table than can be processed between the presentations of two ideas. Production blocking describes the phenomenon that in a group scenario, only one participant can speak at a time. Members may forget their respective thought when they are not able to communicate it immediately – or put in other words, thought-in-progress is interrupted. Evaluation apprehension occurs in situations in which group members are likely not to communicate their ideas out of fear they may seem unworthy, ridiculous, too simple or too original to satisfy the other group members. Free riding describes a quite contrary concept. Since the members of the group expect their results to be analyzed at group level only, they either lose motivation because they feel to be underrated or they feel no need to engage in the group work at all because they feel that the others will produce sufficient results.

Shedding the light of the Media Synchronicity Theory on group communication

These losses lead to the perception that communication is a central concept for creative group processes. Group members are to get the possibility to communicate and interact to share knowledge and feedback on shared ideas (Paulus 2000). But since the modes of thinking change throughout the process, the question remains if modes of communication can remain unchanged. Indeed, the Media Synchronicity Theory proposed by Dennis and Valacich (1999) distinguishes between the features of communication serving either convergent or divergent needs. They identified five media characteristics that can affect communication: immediacy of feedback, symbol variety, parallelism, rehearsability and reprocessability.

Immediacy of feedback refers to the ability to directly address and question a speaker, thus to have a true dialog. Symbol variety refers to the different ways in which information can be communicated. Dennis and Valacich call it the "height" of a medium. A medium of high parallelism is able to process many simultaneous conversations ("width" of the medium). Rehearsability is the extent to which to which the media enables the individual to revise the message before submitting and reprocessability describes the extent to which the information can be re-examined or processed again.

To sum up, there are two different stages in creative group processes, namely idea generation and idea evaluation, there are several losses, which often occur in group processes, which are information overload, production blocking, free riding and evaluation, and there are five different media characteristics that can affect communication in such a group process. Our aim is to connect those three different dimensions in order to come up with a best possible media choice for the two stages bearing in mind the losses that can occur.

The Relationship between Creative and Group Processes

In the 1950s Bales (1950) developed a system of interaction process analysis (IPA) which became a de-facto standard for empirical group research. He identified instrumental concerns that problem-solving groups are continuously faced with. Within these concerns, the interaction processes in a group are divided in three sequential phases: orientation (gathering information), then the evaluation of that information and finally decision-making on the basis of this information. The first two phases have are in correspondence with the aforementioned creative process phases of idea generation and idea evaluation and therefore bridges the gap between creative and group processes.

Coordination

Malone and Crowston (1994) define coordination as the management of dependencies among activities. Through the identification of various types of dependencies existent in most scenarios where coordination occurs, processes can be identified to manage these dependencies. Both researchers contributed to the recovery of fundamental coordination processes that occur in all coordinated systems. They therefore analyzed coordination processes from various research disciplines. The coordination processes are clustered in four categories which we interpret in the light of group cooperation scenarios: (1) the dependencies of shared resources are among the most frequent occurring in collaboration scenarios. Group activities are dependent on each other in that data that they work on is shared and often cannot be accessed simultaneously. Various (group) tasks depend on a restricted capacity of employees responsible for task completion. These dependencies are to be resolved by processes managing those shared resources and more specifically the task assignment and prioritization process. (2) Even though, especially creative group tasks very often do not occur in sequence, predefined sequential tasks, very often producer/consumer dependencies can be identified (e.g. review processes). The artefact creating task has to be accomplished completely before the respective review activity can initiate. Activity sequencing is one coordination processes to resolve this dependency. (3) Scenarios occur where tasks must or must not occur simultaneously. This is the case in meetings, where required group members have to participate at the same time or digital resources have to be "synchronized", i.e. blocked for simultaneous write access. Time scheduling or access synchronization is among numerous processes managing this dependency. (4) Projects in which groups engage to cooperatively elaborate a product or services have to be broken down in work packages (Work Breakdown Structure (WBS)) to allow for project management (PMI 2004). In consequence the overall task of the project depends on its work packages – the task-sub-task dependency occurs. Surely the act of task decomposition is an intellectual process which hardly can be conducted by a standardized management process. However the organization and documentation of work packages is subject to those processes. In the remainder of this paper we will discuss the impact of group process losses and coordination processes on idea generation and idea evaluation to subsequently indicate groupware functionality to foster group performance in the creative process's phases.

ADEQUATE GROUPWARE SUPPORT FOR CREATIVE GROUP PROCESSES (CGP)

Group Losses in Idea Generation and Idea Evaluation

The CGP has two major stages, the collaborative idea generation and subsequent idea evaluation. In accordance to their diverse divergent and convergent character (Helquist et al. 2008) different group losses and coordination processes account for each of them. In the stage of idea generation the retrieval and distribution of task relevant knowledge is predominant. Thus group communication in this stage can produce information overload for its members. At the same time production blocking is very probable to occur since a huge amount of information can be exchanged at the same time. Idea generation heavily relies on the personal involvement of each group participant. Consequently free riding on ideas of other group members is most likely to happen for more passive members. Taking a chance in contributing new ideas beside the conventional thinking paths predominant in the group gives way to criticism which in turn could lead to evaluation apprehension.

In contrast to idea generation most mentioned group losses do not account for idea evaluation. After pre-structuring of ideas, information overload is less likely to happen. Contributing one's own opinion on an idea is supposed to be the minimum contribution of every group member – thus free riding does not account for this stage. Evaluation apprehension surely accounts in the evaluation phase since judging on one's colleagues' ideas is subject to group conflicts. Referring to the

aforementioned possibility of anonymization in groupware applications, we consider this group loss to be irrelevant in idea evaluation. However, a vivid discussion of generated ideas can lead to a high parallelism in communication and therefore is subject to production blocking. The phase of evaluation is where personal opinions are discussed. Here dominant group members are likely to have influence on the group's decision making. Thus dominance is of relevance in this phase.

Coordination Processes in Idea Generation and Idea Evaluation

Since the phase of idea generation is a divergent one, where ideas from every participant are collected, there is consequently no need for the management of shared resources, the management of producer/consumer relationships or the management of task/subtask relationships. At this starting point in the process, it is unlikely that resources have to be shared. Results, products, etc. will rarely have to be transferred, as tasks will be rarely broken down into subtasks. However, managing simultaneity is important, since no information should get lost in this divergent thinking phase.

In contrast to the idea generation phase, where coordination (apart from the management of simultaneity constraints) is not that crucial, most coordination processes are relevant in the idea evaluation phase. When thinking about collaborative work and merging many ideas to concentrate on a few promising ones, managing shared resources, producer/consumer relationships and task/subtask relationships becomes important because all participants need to be coordinated in their activities. Since decisions do not have to be taken concurrently, the management of simultaneity constraints is irrelevant in the idea evaluation phase.

This correlation of group losses, coordination processes and CGP stages is subsumed in table 1.

Phases/Focus		**Idea Generation**	**Idea Evaluation**
Group losses	Information Overload	Relevant	Irrelevant
	Production Blocking	Relevant	Relevant
	Free Riding	Relevant	Irrelevant
	Evaluation Apprehension	Relevant	Irrelevant
Coordination Processes	Management of shared resources (task allocation)	Irrelevant	Relevant
	Management of producer/consumer relationships	Irrelevant	Relevant
	Management of simultaneity constraints	Relevant	Irrelevant
	Management of task/subtask relationships	Irrelevant	Relevant

Table 1: Group Losses in the two different stages of the CGP

Reducing group losses with the choice of the right media characteristics

Communication media can be described by the aforementioned characteristics of the Media Synchronicity Theory. We assume that the latter have low or high as parameter value. We now discuss which value is most likely to reduce group losses (see Figure 2). Media characteristics that do not have impact on certain group losses are omitted.

One of the major challenges for group communication is the information overload caused by its members. A high symbol variety, e.g. encompassing pictures, videos and other media will help group members to express themselves in an adequate way. A risky media characteristic in this context is parallelism. This form of communication can overburden ones information processing capabilities and therefore should be held on low level. Not only is the quantity of messages subject to a potential loss in group processes. Also their quality can lead to problems as wrong information could be spread in the group. Therefore a high degree of rehearsability should be the media characteristic of choice.

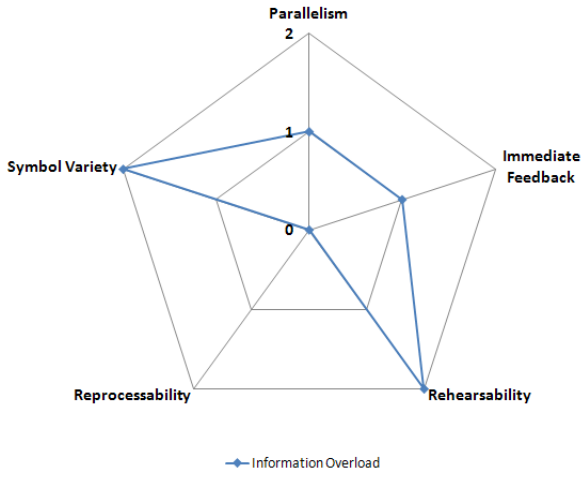
Production blocking can be reduced by media of high parallelism. A group member can participate in different discussions at the same time and therefore communicate a high amount of information in a short time. Given the possibility of immediate feedback to other group members will avoid the blocking of one's spontaneous contributions. This may lead to the situation that a group member will pick up an argument communicated by someone else in the group and immediately respond to it without waiting for the other group member to finish. Also situations might occur where even more than these two communication partners might contribute information at the same time. This requires for media that "stores" the messages exchanged and by this guarantees their reprocessability.

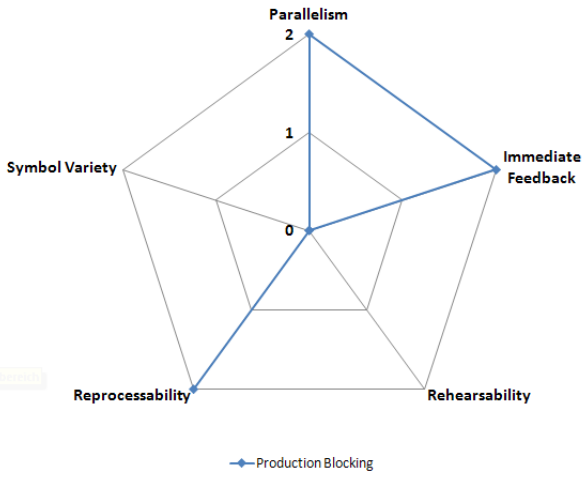
To rely on other group members contributions without involving actively in a discussion is referred to as free riding. Imposing control on the quantity of members' contributions could be one way to face this problem. This is facilitated by the documentation of messages to assure their reprocessability. The motivation of group members to contribute to a discussion or task can be elevated if one is given the possibility of the preferred means of expression. A high degree of symbol variety offers the choice to post a text or instead a picture or audio file according to the preferences of the sender.

Evaluation apprehension is encouraged when group members have the opportunity to immediately respond to contributions of others. Consequently media that averts immediate feedback contributes to the reduction of this loss. At the same time contributions of members that will have the opportunity to "fine-tune" them before submitting to the group will be of higher quality and less likely to encounter criticism. This speaks in favor of a high degree of rehearsability. The documentation of members' contributions, though, will open way to trace them for later use. They therefore have a higher weight for its sender who in turn will feel more uncomfortable to contribute. Thus reprocessability should be avoided.

As stated before all mentioned group losses are relevant for the creative process stage of idea generation. To facilitate the recommendation of appropriate groupware functionalities we subsume the media profiles for the different group losses in one profile. For this we count the value occurrences for each media characteristic in all different group losses and recommend the value with the highest quantity. When equal numbers occur, recommendation for groupware design is omitted.

According to this strategy, the optimal media profile for the stage of idea generation is a low degree of immediate feedback and a high degree of rehearsability, reprocessability and symbol variety. Since the process stage of idea evaluation is affected by production blocking only, the optimal media profile of the latter is the optimal media profile for the evaluation stage.





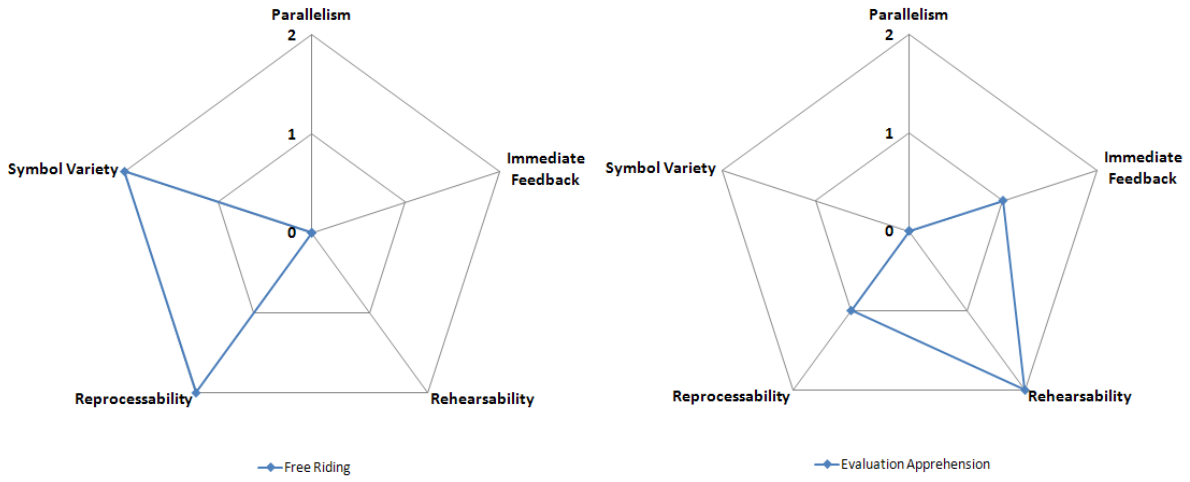


Figure 1: Optimal media profiles to reduce group losses (1: low, 2: high, 0: omitted)

We subsequently elaborate the coverage of media characteristics by different groupware functions and afterwards match them to the optimal media profiles.

Identifying media profiles of groupware functions for the definition of groupware support to best reduce group losses

In order to higher our contribution for the recommendation of optimal groupware design to reduce group losses we further consider concrete groupware functionality instead of rather general groupware categories. It later shows up that this bottom-up approach converges to a more general recommendation of functionality choice. Table 2 summarizes the matching of these functionalities to media categories, again with a binary scale discriminating the values high and low.

Groupware Functionality /Media Characteristics	Symbol variety	Parallelism	Immediacy of Feedback	Rehearsability	Reprocessability
Messenger	Low	High	High	High	High
Forum	Low	Low	Low	High	High
Chat	Low	High	High	High	High
E-Mail	High	Low	Low	High	High
Video Conferencing	High	Low	High	Low	Low
Data Sharing	High	Low	Low	High	High
Optimal Media Profile for Idea Generation	High	(Low)	Low	High	High
Optimal Media Profile for Idea Evaluation	Low	High	(High)	High	High

Table 2: Media profiles of groupware functionality

Messenger, forum and chat functionality offers low symbol variety as it focuses mainly on text messages. In contrast e-mail (with attachments), video conferencing and data sharing allows for high symbol variety supporting different file formats or rich video experience. Messenger and Chat obviously provide the possibility to have different discussions concurrently as opposed to forum, e-mail, video conferencing and data sharing being all asynchronous communication means (Ellis et al. 1991). A high immediacy of feedback is given with messenger, chat and video conferencing functionality, either through rapid text messages or direct personal response. Again for reasons of asynchrony, forum, email and data sharing is low in this media characteristic. Rehearsability is given in all functionalities except for video conferencing, either by capturing text transmitted, or in case of data sharing by any data format saved. Video conferencing does not account for this (assuming that video sessions are not recorded).

We oppose this media profiles with those identified before to be optimal for reduction of group losses in the two different CGP stages of idea generation and evaluation. In table 2, identical background shapes for functions and media profiles show the highest consensus of matching values. Accordingly idea generation is best supported by forum, email and data sharing functionality. It is striking that this functionality appertains to the group of asynchronous groupware. On the contrary, idea

evaluation is best supported by messenger and chat functionality, both being exponents for synchronous groupware functions. Apart from the theory based approach we pursued for our line of argument, this conclusion seems to be convincing since the generation of ideas is more likely to happen in persistence oriented systems whilst communication for evaluation is more likely to happen in transient conversation.

Video conferencing is the underdog in this analysis. This again can be explained intuitively. Video conferencing systems are the most realistic imitation of face-to-face communication which revealed the group losses identified by Nunamaker et al. (1991).

Appropriate Groupware functionality for distinct coordination processes

Groupware functionality to support coordination processes can be clustered in functions for time management, file sharing and task management (See table 3). Within the first cluster, shared calendars support the management of the shared resource of time the group member have for group meetings or workshops. This is related to simultaneity management since group meetings surely depend on simultaneous availability of members. Gant diagrams visualize work packages, i.e. tasks and how they are to be assembled to complete an overall work package or project. This is the case for sequential work packages as well as partially parallel work packages. Accordingly producer/consumer relationships and simultaneity constraints can be managed. The file sharing functionality of file synchronization through decentral availability of files in the internet is of substantive support for the management of shared digital resources. Moreover throughout the working progress intermediate versions of files can be provided the last author to the next which embodies the management of producer/consumer relationships. Simultaneous access to the files is in the scope of file synchronization implementations. The focus of tree structures is the management of task/subtask dependencies. Work packages, files, roles or group members can be organized in a hierarchical structure. Within the cluster of task management Group Task is an abstract concept that allows a group to work collectively on the completion of a task. Thus, from the perspective of task responsibility, task members as a resource necessary for task completion, can be assigned to Group Tasks, thereby managing task allocation. As with the shared calendar also simultaneity constraints are resolved by group tasks. Moreover, group tasks can be organized hierarchically. One Group Task can consist of several other sub Group Tasks or even privately owned tasks. The most rigid way to coordinate dependencies is through process automation, i.e. workflows. Considering their relatively restricted field of possible application for highly structured processes, workflows control the execution of task through predefined routing. Generally this can be of a strictly sequential form, managing producer/consumer relationships, or in parallel, i.e. for the management of simultaneity constraints. Also a mixture of both concepts can be managed within one workflow.

Groupware Functionality /Coordination Processes	Management of shared resources (task allocation)	Management of producer/consumer relationships	Management of simultaneity constraints	Management of task/subtask relationships
Time Management				
Shared Calendar	High	High	High	Low
Gant Diagram	Low	Low	High	High
File sharing				
Internet file synchronization	Low	High	High	Low
Folder Hierarchies	Low	Low	Low	High
Task Management				
Group Tasks	High	Low	High	High
Workflows	Low	High	High	Low
Relevance in Idea Generation	Irrelevant	Irrelevant	Relevant	Irrelevant
Relevance in Idea Evaluation	Relevant	Relevant	Irrelevant	Relevant

Table 3: Media profiles of groupware functionality
(High = high support for coordination process, Low = low support for coordination process)

Which insides can we gain from this analysis? First of all, different groupware functionality pertaining to the same cluster exhibit different properties in their support of coordination processes. This conceptual insight is one reflection of the very

numerous attempts to categorize groupware functionality all leading to different results. Secondly, we can identify groupware functionality that is appropriate for the support of different phases of the creative group process, according to their demand of coordination management. Since idea generation predominantly demands for the management of simultaneity constraints, both representative functions of time management, file synchronization and the mentioned task management functionality is valuable groupware functionality. For idea evaluation no tendency of distinctively appropriate management support demand, respectively functionality support is identifiable. This resides from the fact that this phase involves major coordination demands and should hereby be supported by a most comprehensive tool. Consequently, there is no single "golden hammer" functionality to most appropriately support idea generation or evaluation. Both phases require for comprehensive coordination functionality.

CONCLUSION AND OUTLOOK

There is an obvious relation between the stages of idea generation and idea evaluation in the creative group process, the group losses that can occur and the media characteristics of the media chosen to communicate. We evidenced that the media profile and the corresponding best groupware functionality depend on the stage of the process. The contrast is true for coordination functionality demand provided by groupware.

The very essence of this paper thus can be subsumed like this: the divergent phase of idea generation in the CGP is best supported by asynchronous groupware function, whilst the convergent phase of idea evaluation in the CGP merits from synchronous communication. Both phases depend on various groupware functionalities to supports necessary coordination.

Our considerations so far lack empirical evaluation. With the design and application of a software prototype in test scenarios we aim to evaluate the correctness of design specifications we deduced. Media Synchronicity Theory proved to be more fruitful in the evaluation of electronic communication through groupware functionality than Coordination Theory did for computer supported coordination. This resides from the fact that Media Synchronicity Theory explicates differentiated media characteristics that serve for single criteria evaluation. We indicated that Coordination Theory does not provide substantive criteria to support in the judgment on the appropriateness of coordination process implementations in a given context. Its merits lay in its provision of a new perspective on what coordination is – the management of dependencies between activities.

REFERENCES

1. Amabile T. (1988) A model of creativity and innovation in organizations, *Research in organizational behavior*, 10, 123–167.
2. Bales R. (1950) Interaction Process Analysis: A Method for the Study of Small Groups, Addison-Wesley, Reading, MA.
3. Basadur M. (1995) Optimal ideation-evaluation ratios, *Creativity research journal* 8, 63–75.
4. Cooper, H. (1988) Organizing Knowledge Syntheses: A Taxonomy of Literature Reviews, *Knowledge in Society* 1, 1, 104-126.
5. Crowston, K., Rubleske, J. and Howison, J. (2004) Coordination Theory: A ten-year Retroperspective, *Human-Computer Interaction in Management Information Systems*, 1.
6. Dennis R. and Valacich J. (1993) Computer brainstorms: More heads are better than one, *Journal of applied psychology* 78, 4, 53–537.
7. Dennis R. and Valacich J. (1999) Rethinking media richness: Towards a theory of media synchronicity, in *Proceedings of the thirty-second annual Hawaii international conference on system sciences*, Honolulu.
8. Ellis C., Gibbs, S. and Rein G. (1991) Groupware: Some issues and experiences, *Communications of the ACM* 34, 1, 38–58.
9. Fouss, J. and Chang, K. (2000) Classifying Groupware, in *Proceedings of the ACM Southeast Regional Conference*, Clemson, South Carolina, 117-124.
10. Guilford J. (1950) Creativity. *American psychologist*, 5,9, 444–454.
11. Hackman R. and Morris C. (1975) Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration, in Berkowitz, L. (Ed.) *Group processes*. Academic, New York.
12. Hall J. (1971) Lost in the moon, *Psychology today*, 51.
13. Helquist, J., Kruse, J. and Adkins, M. (2008) Participant-driven collaborative convergence, in *Proceedings of the 33rd Hawaii international conference on information system science.*

14. Hitt, W. (1965) Towards a two-factor theory of creativity, *Psychological record*, 15, 127–132.
15. Kristensson, P. and Norlander T. (2003) The creative product and the creative process in virtual environments, *Creativity and innovation management*. 12, 1, 32–40.
16. Malone, T. and Crowston, K. (1994) The interdisciplinary study of coordination, *ACM Comput. Surveys*, 26, 1, 87-119.
17. Mejias, R. (2007) The interaction of process losses, process gains, and meeting satisfaction within technology-supported environments, *Small group research*, 38, 156–194.
18. Nunamaker, J., Dennis, A., Valacich, J., Vogel, D. and George, J. (1991). Electronic meeting systems to support group work, *Communications of the ACM*, 34, 7, 40–61.
19. Osborn, A. (1957) Applied imagination: Principles and procedures of creative thinking. Scribeners, New York.
20. Paulus, P. (2000) Groups, teams and creativity: The creative potential of idea-generating groups, *Applied psychology: An international review*, 49, 2, 237–262.
21. PMI (2004) A Guide to the Project Management Body of Knowledge, Project Management Institute, Pennsylvania.
22. Riemer, K. and Vehring, N. (2008) E-Collaboration Systems in Virtual Organizations – Recommendations for Tool Support based on Genre Analysis, in *Proceedings of the Americas Conference on Information Systems (AMCIS*), Toronto.
23. Runco, M, and Chand, I. (1995) Cognition and creativity, *Educational psychology review*, 7, 243-267.
24. Santanen, E., Briggs, R. and de Vreede, G-J. (2000) The cognitive network model of creativity: A new causal model of creativity and a new brainstorming technique, in *Proceedings of the 33rd Hawaii international conference on information system science*.
25. Shneiderman, B. (2000) Creating creativity: User interfaces for supporting innovation, *ACM trans. on computer-human interaction*, 7, 1, 114-138.
26. Simonton, D. (2006) Creativity around the world in 80 ways… but with one destination, in Kaufman J., Sternberg R. (Eds.) *The international handbook of creativity*. Cambridge University, New York.
27. Steiner, I. (1972) Group process and productivity, New York, Academic Press.
28. Taylor, W., Berry, P. and Block, C. (1958) Does group participation when using brainstorming facilitate or inhibit creative thinking?, *Administrative science quarterly*, 3, 1, 23–47.
29. Wallas, G. (1926) The art of thought. New York.
30. Webster, J. and Watson, R. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26, 2.